

Report on manuscript “Non-Chiral Vertex Operator Algebra Associated To Lorentzian Lattices And Narain CFTs by Ranveer Kumar Singh, Madhav Sinha

In this paper, the authors introduce the concept of *non-chiral VOA*, which gives a mathematical definition of conformal field theory, derive its basic properties, and mathematically construct a family of conformal field theories called Narain CFT. However, as pointed out below, a great number of definitions, propositions, and main theorems have **already been written** in the previous work [1] (submitted to arXiv in 2020).

In [1], Moriwaki introduced the notion of *full VOA* and showed that a full VOA admits exactly marginal deformations if the full VOA has Heisenberg VOA as a subalgebra. In particular, he constructed the Narain CFT as a concrete example of such a deformation family [1, Section 6.3].

However, this paper **only mentions a single sentence** in the introduction about prior work, and re-proves the same proposition and theorem in essentially the same way, without proper **citation**. **This paper should be properly rewritten to show what is new and what is an existing result.**

(Several comments)

The novelty of this paper lies in the following points, for example:

- The definition of non-chiral VOA in this paper differs from that in [1]. In [1], full VOA is defined using bootstrap equation, but in this paper, it is defined using locality of multi-point correlation functions. In particular, it is not fully checked in [1] that Narain CFT constructed in [1] satisfies the axiom of non-chiral VOA in the sense of this paper.
- Note that If it is a non-chiral VOA, then it is a full VOA in the sense of [1] (Proposition 2.2 in this paper). Although most of the pages of this paper overlap with [1], the referee believes that it is appropriate to take the form of a citation for these overlapping propositions, and that it is appropriate to recapitulate only the new parts as a new paper.

Some examples that require citation:

- Lemma 2.1, Lemma 2.2, Lemma 2.3, Prop 2.1, Prop 2.2 can be found in [1, Prop 3.7 and Section 4.3]
- Definition of chiral vector (def 2.2) can be found [1, Section 3.2] and modules [1, Section 3.1].
- Theorem 2.1 can be found in [1, Lemma 3.11]
- Construction of Narain CFT as full VOA can be found in [1, Section 4.4, Prop 4.10]
- Double coset description [1, Theorem 6.5] with example for Narain CFT [1, Section 6.3]

[1] Two-dimensional conformal field theory, full vertex algebra and current-current deformation, Adv. Math, **427**, 2023